## REMARKS/ARGUMENTS

The office action was made Final. It is believed, however, that the finality was premature and the foregoing amendments place the application in condition for allowance, so it is respectfully requested that the finality of the office action be rescinded and the amendments entered.

Claims 2, 3 and 10 - 40 are pending in the application.

System claim 17, transmitter claim 20 and receiver claim 25 have each been amended to distinguish the invention more clearly from the references cited in the office action. Similar amendments have been made to the corresponding method claims 30 (transmission and reception), 33 (transmission only) and 36 (reception only).

In paragraph 2 of the Office Action mailed May 11, 2006, the examiner dismissed applicant's previous arguments as not persuasive and, in paragraph 4 of the Office Action, rejected claims 11, 15, 17, 20, 25, 30, 31 and 36 under 35 U.S.C. 102(e) as anticipated by US6,473,467 (Wallace *et al.*).

The rejection is respectfully traversed on the grounds that the examiner has erred in construing applicant's claims as reading onto Wallace *et al.*'s disclosure.

It seems clear from the latest Office Action that the examiner is confusing Wallace *et al.*'s channels of their multiple-input multiple output (MIMO) communications system with the present applicant's sub-channels or sub-bands. Referring to FIG. 3 of Wallace *et al.*'s disclosure, their MIMO system combines multiple inputs $S_1, S_2, ..., S_K$ and transmits multiple output signals $V_1, V_2, ..., V_{NT}$, each by way of a respective one of several antennas 116A, 116B, ..., 116T. The signals $V_1, V_2, ..., V_{NT}$ are modulated in separate channels by modulators 114A, 114B, ..., 114T. It is important to note that, following modulation, the signals $V_1, V_2, ..., V_{NT}$ are not combined. Rather, each signal is transmitted by its own antenna.

It is also important to note that, although Wallace *et al.* mention sub-channels in the passage quoted by the examiner (Col. 20, line 59 to Col. 21, line 7), they are describing what is happening within a single one of the channels A, B, .... T. Thus, they state "In FIG. 3, each modulator 114 includes an IFFT 320, ...." and "IFFT 320 can be designed to perform the IFFT on any number of sub-channels (e.g., 8, 16, 32, and so on)." Thus, within a particular channel A, B, ..., T, only the one IFFT 320 is used to process all of the sub-channels. This is, of course, feasible if relatively few sub-channels are involved. When the number of sub-channels is much larger, for example more than 8000, it leads to the problem addressed by the present invention.

In embodiments of the present invention, the many sub-band signals are processed independently but then are combined into a single signal before transmission, identified as "signal out" in the present applicant's Fig. 3. It will be seen, therefore, that the present applicant's transmitter (see Fig. 3) should be compared with only one of Wallace *et al.*'s channels A, B, .... T.

When that is done, it is clear that Wallace *et al.*'s disclosure does not anticipate any of the present applicant's independent claims because:

(i) if the present applicant's sub-band signals are equated to Wallace *et al.*'s channel signals $V_1, V_2, ..., V_{NT}$, Wallace *et al.*'s signals are not combined before transmission, and

(ii) if the present applicant's sub-band signals are equated to Wallace *et al.*'s sub-channels within any one of the IFFTs 320, Wallace *et al.*'s sub-channel signals are processed by a single IFFT.

Clearly, therefore, there is no anticipation of claims 11, 15, 17, 20, 25, 30, 31 and 36 and the rejection under 35 U.S.C. 102(e) should be withdrawn.

Notwithstanding the foregoing, it is acknowledged that the present applicant's claims lacked clarity because they did not differentiate clearly between the sub-bands, into which the total bandwidth was divided, and the actual sub-band signals modulated by the portions of data into which input data is divided for processing and transmission. Also, they did not explicitly state that the sub-band signals were subsequently combined for transmission via a single transmission channel. This has been resolved by the foregoing amendments to independent claims 17, 20, 25, 30, 33 and 36. It is requested that these amendments be entered, despite the finality of the Office Action, because they merely clarify what was implicit when the claims were read in the context of the specification taking into account the common general knowledge of those skilled in this art, and they put the application into condition for allowance.

The rejection of claims 2, 3, 10, 12, 13,14, 16, 21, 22, 26, 27, 32, 33, 37 and 38 under 35 U.S.C. 103(a) as unpatentable over Wallace *et al.* in view of Murakami (US 6,317,409) is respectfully traversed. In so far as each of those claims is dependent upon one of claims 17, 20, 25, 30, 33 and 36, and includes all of its limitations, the foregoing arguments with respect to Wallace *et al.* apply and the combination fails, so there is no *prima facie* case of obviousness .

Notwithstanding that, the rejection should be withdrawn because it is based upon an incorrect interpretation of the present applicant's claims and the cited reference by Murakami.

Following submission of the previous response on February 21, 2006, claim 3 states "*wherein the transmitter has a modulator to process each sub-band separately prior to implementation of the IFFT and up-sampling means in advance of the filter to up-sample each sub-band signal to the desired sampling rate, ...*".

This wording reads onto Fig. 3 of the present application, which shows, in each band or channel, a (QAM) modulator, an IFFT means, an up-sampling means (M) and a passband filter. The examiner acknowledged in the Office Acton that Wallace *et al.*'s disclosure did not disclose the features of claim 3, but actually misquoted the claim by omitting the term "IFFT". This omission was repeated in line 1 of page 8 and might explain why the examiner erroneously concluded that Murakami disclosed the features of claim 3. If claim 3 is read correctly, and Murakami's Figures 1 and 2 are combined by adding the modulator 3 and transmission channel 4 to FIG. 2, as shown in Appendix A hereto, it is clear that Murakami's modulator 3 does not "process each sub-band signal separately prior to implementation of the IFFT" because it is located after box 1 which contains the

IFFTs 120. Consequently, the statement in the Office Action that Murakami discloses "a modulator (FIG. 1, Modulator 3) to process each sub-band signal separately prior to implementation of the and (*sic*) up-sampling (FIG. 2, up-sampler 130) means in advance of the filter (FIG. 1, Q0(z), Q1(z); column 4, lines 20-22; column 5, lines 28-43) to up-sample (FIG. 2, up-sampler 130) each sub-band signal to the desired sampling rate,..." is simply incorrect.

There is nothing in either of the cited references which would motivate the skilled addressee to try combining them in the manner proposed by the examiner. Indeed, even if one tried to follow the examiner's proposal, he would not arrive at the claimed invention.

It is noted that, in embodiments of the present invention, although the sub-signals after IFFT processing are in the same frequency band, after up-sampling by M and filtering by different filters, the sub-band signals will be moved to M different frequency bands (in the simple case where all IFFTs are the same size). Because they occupy different frequency bands, they can be combined together and transmitted at the same time.

It should also be appreciated that up-sampling-plus-filtering to move the location of the sub-band signals in the frequency domain before combining all sub-band signals together allows the usual one large size IFFT operation to be replaced by a set of small size IFFT operations. In Wallace *et al.*'s system, the change of location of the sub-bands in the frequency domain is achieved by up-converter 324 and the time domain signals are "converted into an analog signal, modulated to a RF frequency, and conditioned (e.g., amplified and filtered) to generate an RF modulated signal that is then transmitted from the respective antenna 116" (Column 21, lines 10-14). Such analog processing would not motivate the skilled addressee to introduce up-sampling, which is a digital technique. Moreover, Wallace *et al.*'s invention addresses MIMO systems in wireless communications whereas the present invention is directed primarily to VDSL systems where the sizes of FFT and IFFT are typically very large. Also, Wallace *et al.* were concerned with "the measurement and report of channel state information" which is unrelated to the problem of large-size FFT/IFFTs and the solution of substituting a set of smaller size FFT/IFFT operations, as taught by the present invention.

For these reasons, a skilled person would not be lead to the present invention by the disclosures by Wallace *et al.* and Murakami, whether taken individually or in combination.

Claims 18, 19, 23, 24 and 28 were rejected under 35 U.S.C. 103(a) as being unpatentable over Wallace *et al.* in view of Murakami and further in view of Kim *et al.* (US6,690,717). This rejection also is respectfully traversed since these claims are dependent upon one or other of the independent claims and so are patentable for the reasons set out herein before. Consequently, the rejection of each of these should be withdrawn.

The applicant reserves the right to rebut the specific rejections of the dependent claims should the need arise. That said, it is noted, for the record, that the examiner appears to have

misunderstood the term "single side band" in applicant's claims. Put simply, the term "single side band" in the frequency domain means that the time domain signal after IFFT is a complex number. One cannot transmit a complex time signal (real+imaginary) without special treatment. In Wallace *et al.*'s system, the signal is transmitted directly after IFFT (beside cyclic prefix and up-converter which has nothing to do with complex single side band signal). Consequently, the signal must be real. In the present application, the special treatment for the complex single side band signal is described with reference to Figures 7 and 8. Also, regarding claim 15 and its equivalents, which require variable (I)FFT size, it should be noted that the cited references by Murakami and Kim *et al.* disclose fixed-size (I)FFTs.

The amendments to the description merely align the Summary of Invention section with the independent claims, as amended.

In view of the foregoing, it is submitted that all claims of record are patentable over the cited references and early and favourable reconsideration of the application is respectfully requested.

Respectfully submitted,

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This is box 1 of FIG. 1

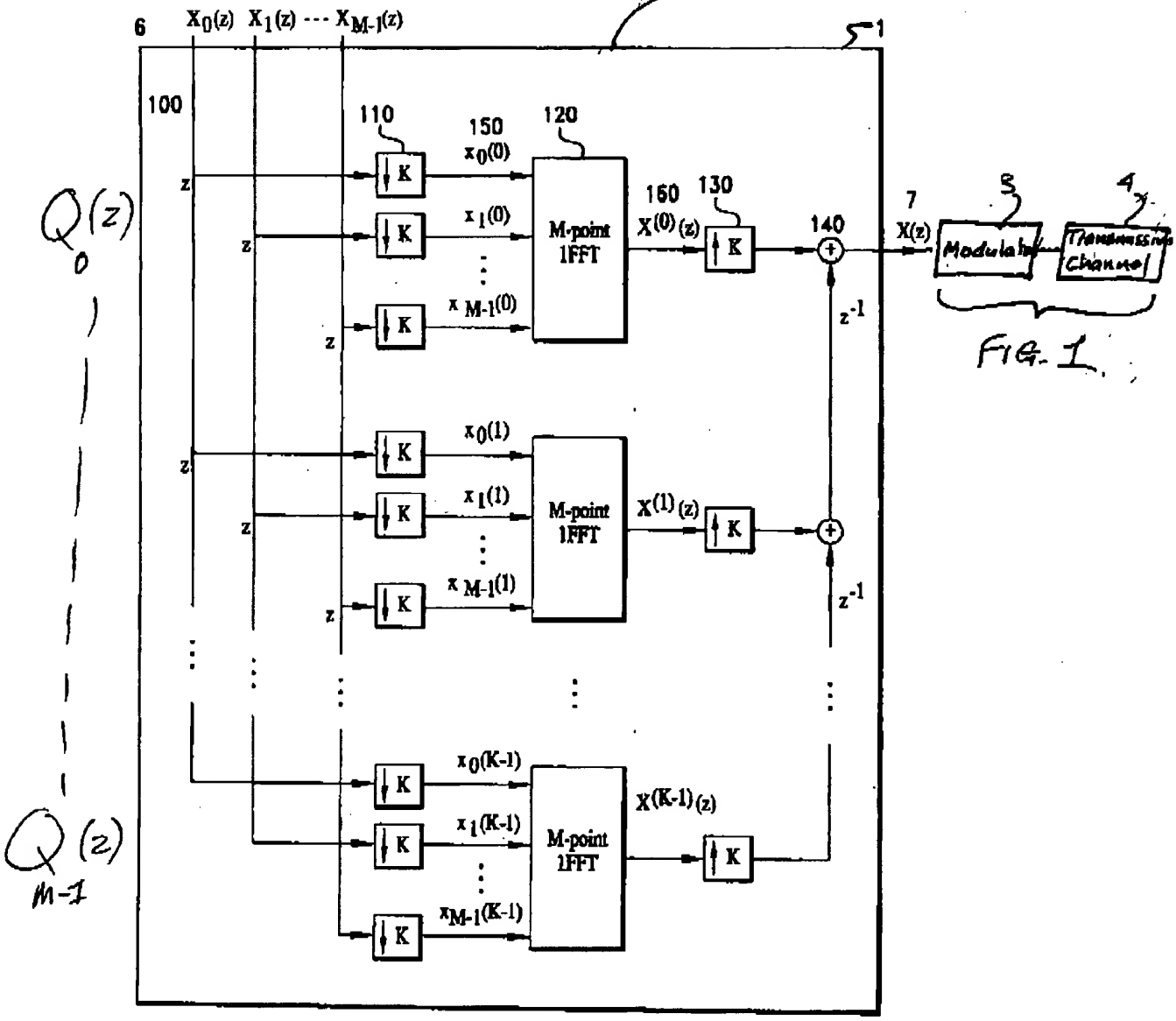


FIG. 1

FIG.2

APPENDIX A